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THE

Sidereal Messenger.

Conducted by Wm. W. PAYNE,

Director of Carleton College Observatory.

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CONTENTS:

"The voice that rolls the stars along,

Speaks all the promises."

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The Sidereal Messenger.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO. *Sidereus Nuncius*, 1610.

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ON A METHOD OF REDUCING DIFFERENT CATALOGUES OF STARS TO A HOMOGENEOUS SYSTEM.

ABSTRACT OF PAPER READ BY WILLIAM A. ROGERS BEFORE THE A. A. A. S. AT THE MONTREAL MEETING.

When two catalogues of stars which have been independently observed are compared, it will be found that there are certain systematic deviations which are functions, either of the right ascension or of the declination, or of both the right ascension and the declination. If all the stars in the two catalogues are compared for each hour of right ascension and the mean of the deviations for each hour be taken, it will be found that this mean is never a constant. So also the mean of the residuals obtained by combining the stars in groups arranged in the order of declination will be found to vary with the declination.

Now our knowledge of the motion of the solar system in space depends upon our knowledge of the proper motions of the stars comprising the stellar system. Since all the catalogues of stars which have ever been made have variations from any normal system assumed, it is necessary to reduce each catalogue to a common system before the observations can be employed in the determination of the proper motion.

It is the common practice to arrange the stars in the

order of right ascension, and to take the mean of the residuals from the normal system chosen for each hour. Since they involve the accidental errors of observation, it is then necessary to obtain a system of mean corrections which shall be as nearly free as possible from these accidental errors There are two methods of doing this:—

I. The analytical method.

If we have a series of residuals $\Delta\alpha$ arranged in the order of right ascension which are strictly circular functions we may always assume $\Delta\alpha$ = a constant $+ m \sin \alpha + n \cos \alpha + m' \sin 2\alpha + n' \cos 2\alpha$ &c.

From the solution of a series of equations of this form the values of m, n, m' and n' can be found by the process of least squares; hence the value of $\Delta\alpha$ becomes known for any right ascension.

II. The graphical method.

If we assume any given unit in right ascension as a horizontal argument, and an aliquot part of $\Delta\alpha$ as a vertical argument, it is obvious that points representing $\Delta\alpha$ may be laid off which will bear a definite relation to a fixed horizontal line. If a smooth curve is drawn through these points, values of $\Delta\alpha$ nearly representing observation may be derived for any right ascension by reading off the vertical coordinate passing through the curve at this point.

Now when the systematic deviations of any catalogue from the normal system have been found by either of these methods and have been applied to the positions of the catalogue, it will still nearly always be found that there are remaining residuals which are functions of the declination. These residuals can be treated either analytically or graphically by the methods just described.

But when the chosen catalogue has been reduced to the normal system by the application of both of these classes of systematic corrections *i. e.* those depending on the right ascension and on the declination obtained independently, there are several catalogues which still show systematic residuals which are functions of both the right ascension and of the declination. It is easy to see why this must be so to a certain extent.

Nearly all catalogues depend upon Bessel's constants of precision. A few however depend upon Struve's constants.

In order to reduce the annual variation for Bessel's constants to those of Struve, we have:

Struve = Bessel + $.001123^s$ + $.000129^s \tan \delta \sin \alpha$.

It will be seen that the variable part of this reduction depends upon both α and δ.

Both of the methods described, for comparing different catalogues with a normal catalogue, are open to the objection that the coordinates of any given star when referred in this way to a normal system may differ by a small amount from the values of the coordinates derived by a direct reduction of the instrumental constants from the fundamental stars of the system. I estimate the uncertainty arising in this way to be $\pm\ 0.015^s$ in $\Delta\alpha$ and $\pm\ 0.20''$ in $\Delta\delta$. In the reduction of the zone stars observed at the Harvard College observatory, the instrumental constants from 1871 to 1876 have been re-computed from the final positions of the fundamental catalogue upon which it is to be based, viz: upon the catalogue of fundamental stars in publication XIV. When therefore the final catalogue is completed, the data will be at hand for a definite determination of the amount of this uncertainty. But since this reduction is entirely impracticable in the case of the catalogues already published, finally, some methods of reducing different catalogues to a homogeneous system is an absolute necessity. Admitting this necessity, *that method is to be preferred which will reduce the residuals $\Delta\alpha$ and $\Delta\delta$ to a minimum whatever the order or the limits of the groups into which they may be divided.*

The method propose is as follows:

(a) The residuals are first arranged in the order of declination. The mean values for any group, represent nearly the corrections for the mean declinations of that group and for twelve hours of right ascension.

(b) The residuals for each group minus the mean value for that group are then arranged in the order of right ascension and a graphic curve is drawn through the points

representing these values. Each curve will give a series of values for the even hours of the right ascensions, which are arranged in vertical columns, the horizontal argument being the mean declination. It will be seen that the values in the vertical columns are derived from the same curve while those in the horizontal columns are derived from different curves. In order to connect the different groups in declination, a curve is drawn through the points represented by the residuals in the horizontal columns. This will of course disturb to a slight extent the values already found in the vertical columns, but they can in turn be rectified in the way already described. A second approximation will ordinarily give smooth curves for both the vertical and the horizontal arguments.

(c) On account of the limited number of residuals which usually compose the groups arranged in the order of declination, there is danger of introducing systematic errors in drawing the graphic curves. Hence after the sum of the two residuals already found, has been subtracted from the original residuals, the new values are arranged in the order of right ascension and a smooth curve is drawn through the points thus found, giving the means of obtaining the slight corrections which still remain.

This method has been followed in a paper printed in vol. X of the Memoirs of the American Academy of Arts and Sciences, on "A comparison of the Harvard College Observatory Catalogue of stars for 1875.0 with the fundamental systems of Auwers, Safford, Boss and Newcomb."

RECENT CONTRIBUTIONS TO OUR KNOWLEDGE OF THE MOON.

"Selenography has lately received a valuable contribution by the publication of the sketches of portions of the moon's disc which were made by Tobias Mayer, at Gottingen, in the middle of the last century. Mayer was the first observer who constructed a general map of the moon in which the positions of the chief lunar spots were laid down from actual measurments, and not from mere eye-drafts. The in-

tended publication of his lunar sketches at the end of the last century was frustrated by the death of Lichtenberg, who had undertaken it, and Mayer's smaller, general map remained the only accessible result of his selenographical labours. To the discussion of any questions referring to physical changes on the moon's surface, the evidence which may be derived from trustworthy sketches made at an early period, is obviously of considerable importance, and the publication of Mayer's old sketches is therefore a welcome addition to the available sources of information. There are forty sketches made between June 1748 and June 1750, and these are reproduced by photoheliography, so that the copies are faithful representations of the originals. They are accompanied by a copy of Mayer's large general map, of nearly fourteen inches diameter; and thus the results of his old selenographical observations, obtained with humble means, have at last become available, and a debt long due to him has been paid by the Gottengen observatory.

Mr. Henry Harrison, of New York, has published a colored lithograph representing the moon as the "three-days-old crescent," or as it appears three days after the time of new moon. As the ordinary lunar maps are constructed with the object of exhibiting the general topography of the whole visible surface, they do not represent, and are not intended to represent, the real aspect of the moon at any time; and it is necessary to have special maps for special phases of illumination if they are to show the shadows and other variable features which are so strikingly characteristic of the moon's appearance at different hours of the lunar day. Mr. Harrison's lithograph is such a special representation, and, as regards general resemblance and artistic effect, may be called a success. Though it does not show more than a small portion of the innumerable details which the telescope reveals, it gives a good notion of the telescopic appearance of the young moon as seen with a comparatively low power. The moon's image is eighteen inches in diameter, the phase represented corresponding to the time when the crater Messier has emerged into the light of the rising sun.

The plate is accompanied by a little descriptive hand-book and an outline map. Its publication will be followed by that of five more plates, containing similar representations of five of the most interesting phases.

Experiments have repeatedly been made with the object of producing natural imitations of the craters and inequalities visible on the moon's surface, and it has been found that the figures of the lunar inequalities can be closely imitated by throwing pebbles upon the surface of a smooth plastic mass, such as mud or mortar. Mr. Meydenbauer, of Marburg, uses a basis of dextrine for the purpose, and drops small quantities of the same material from a moderate height upon that basis. A photograph of various figures which are thus produced show a remarkable resemblance to the various inequalities visible on the moon's surface."
—(A. MARTH, in the London *Academy.*)

ON THE PERFORMANCE OF A NEW FORM OF LEVEL INVENTED BY MR. JOHN CLARK, OF THE U. S. COAST SURVEY.

ABSTRACT OF PAPER READ BY WILLIAM A. ROGERS BEFORE THE A. A. A. S. AT THE MONTREAL MEERING.

Experienced observers have often expressed the opinion that the level as ordinarily constructed cannot be regarded as an instrument of precision. It will be admitted on every hand that it is not made by a scientific method. In fact the method of construction is of the most crude kind. The maker chooses a glass cylinder as uniform in thickness and density as he can obtain and proceeds to grind an interior curve of unknown radius with an emery and a polishing tool He has no means of determining the exact radius by observation. He is unable to test the equality of the curvature on each side of the center, until after the cylinder has been filled with a fluid and after the ends have been hermetically sealed. Even then the test is only a relative one. It is of the same kind as the observations which are made with the completed level.

As the result of many years of experience I have reached

the conclusion that an astronomical level can be regarded as an instrument of precision only when it is subjected to adequate tests during the series of observations in which it is employed. A given level may measure small angles with great precision but the same level under different conditions may give untrustworthy results.

Even with an instrument which has no graduated circle an adequate level-trier can be constructed by placing a graduated scale at a known focal distance. In the case of the meridian circle of Harverd College observatory the level is placed in Y's attached to the cube of the instrument placed parallel with the optical axis.

In order to show the necessity for repeated and continuous observations for the determination of the value of one division of the level, I record here my experience with the companion level of the instrument known as the Russian Transit. It was made in the work-shop of the Pulkova observatory. I began the observations about 8 o'clock in the morning, Nov. 13, by comparing the readings of the circle with bubble first at the middle of the tube and then at the extreme end. Proceeding in this way with each five divisions in succession I was surprised to find not only a continued diminuation of the value of one division but a well defined shifting of the zero of the level.

By noon I had nearly completed the examination for the first half of the divisions. I then opened the shutters for an observation of the sun. After an interval of ten minutes, observations with the level were resumed, when it was found that the value of one division, determined from the same space as before had increased by one-fourth of its mean value. It will be sufficient to give in illustration the results of the observations on three days:

1881 Nov. 13.

Shutters closed, one division = 1.76", thermometer = 38°
Shutters open, one division = 2.08", thermometer = 61°

1881 Nov. 14.

Shutters closed, one division = 1.20", thermometer = 40°
Shutters open, one division = 2.06", thermometer = 70°

1881 Nov. 15.

Shutters closed, one division = 2.06", thermometer = 47°
Shutters open, one division = 1.78", thermometer = 36°

In these observations the level was held in position in the Y's with a light spring. A second series of observations was made with the tube mounted as follows: At the suggestion of Mr. Geo. B. Clark, oval rings of brass were fitted loosely upon the tube and held in position with wax.

These rings were then placed in Y, one end being fastened with a spring clip while the other end was free. A third series was made with the tube fastened directly to the cube of the telescope at its neutral points by means of a hard cement. The results are given below.

Series I.		Series II.		Series III.	
1881.		1881.		1881.	
May 22	1 div.=2.90"	Nov. 23	1 div.=1.63"	Oct. 7	1 div.=2.25"
22	2.68			7	2.25
Sept. 1	2.60	25	2.48	8	1.64
7	1.83			8	1.62
7	1.92	29	2.18	8	1.65
8	2.83			9	1.62
		1882			
9	2.74	Jan. 8	1.80	9	1.59
12	3.42			12	1.71
13	2.89	Jan. 12	1.94	13	0.83
				13	1.28
				13	1.17
				20	1.23
Means	2.65		2.07		1.57

It is hardly necessary to say that this level has been discarded as worthless.

A similar test with a level invented by Mr. John Clark gave excellent results. The level tube is supported upon centers which are attached to a plate which revolves freely upon another plate described by the inventor as a "reference plate." This "reference plate" is attached to the cube of the telescope by three adjusting screws. The following are the steps of an observation:

The telescope pointing north, the bubble is read for position east and position west. The telescope pointing south, the level is now on the under side of the cube. Revolving the tube upon its centers 180°, the bubble is read as before. This level therefore gives not only the inclination of the axis but the ellipticity of the points.

This form of level is especially adapted to the easy determination of the value of one division. I give below the results of the determinations thus far made. The separate results are the results of observations on different days.

											Means.
1881	Sept.	2.78″	2.71″	2.79″	2.80″	2.96″	2.87″	2.87″	3.07″	2.63″	2.83″
	Oct.	2.61	2.99	2.79	2.53						2.73
	Nov.	2.82	2.88	3.11	3.46	2.85	2.84				2.74
	"	2.91	2.95	2.69	2.71	2.98					
	Dec.	2.85	2.96	3.13							2.98
1882	Feb.	3.21	2.97	2.69	2.77	2.99	2.62				2.87
	Mch.	2 73	3.21								2.97
	Apr.	2.92	2.80	3.01							2.91
	May	2.85	2.93								2 89
	June	2.87	3.01								2.99

The steadiness of the level of the instrument is something remarkable.

The following are the results of the seperete observations:

1882	Feb.	3	$b = +.78^s$	Apr.	3	$b = +.77^s$	June	25	$b = +.74$
		5	$= +.81$		14	$+.80$	July	3	$+.63$
		14	$= +.82$		24	$+.81$		10	$+.72$
		23	$= +.80$	May	1	$+.79$		31	$+.61$
		26	$= +.80$		15	$+.75$	Aug.	16	$+.71$
	Mch.	5	$= +.78$		29	$+.72$		25	$+.68$
		14	$= +.73$	June	11	$+.61$	Sept.	7	$+.66$
		20	$= +.74$		19	$+.66$		25	$+.61$
							Oct.	2	$+.65$

THE EARTH.

We extract the following review (by G. F. Rodwell) of an important book from the *Academy* entitled: *The Physics of the Earth's Crust* by the Rev. Osmond Fisher. (Macmillan.)

"The author in twenty-one chapters discusses the principal facts connected with the interior heat of the earth, the elevations and depressions of its surface, and the causes and effects of volcanic action. He shows that the rate of increase of temperature, as the distance beneath the earth's surface is augmented, is, on the whole, an equable one, and may be taken to average abont 1° F. for every fifty-one feet

(misprinted degrees, p. 267) of descent. And thus at a depth of about thirty miles all known rocks would be in a state of fusion. As to the condition of the interior of the earth, we are first led to a discussion of the density. The surface density is between 2.56 and 2.75, while the mean density of the whole earth is 5.5. Thus the density considerably increases as we approach the centre of the earth. Everything points to the conclusion that the earth has once been in a molten condition: the main question for consideration is whether it is still molten within, or whether this condition has passed away, and it is now solid. It has been thought by some, however, that the interior of the earth may be "potentially hot"—that is to say, really solid on account of the enormous pressure to which it is subjected but ready to become fluid at any moment when the pressure is diminished or removed. Having discussed the arguments of Hopkins and of Sir William Thompson, the author asserts that the requisite great rigidity which the earth must possess in order to enable it to resist the deforming influence of the attraction of the sun and moon does not require that the earth should be absolutely solid from the centre to the circumference. A rigid nucleus nearly approaching the size of the whole globe, covered by a fluid sub-stratum of no great thickness in comparison with the radius, with an outer crust of less density floating upon it, would meet the difficulty. "This is the supposition," says the author, "as to the condition of the earth, which appears, on the whole, to satisfy best the requirements both of geology and of physics." Thus the solid nucleus would owe its solidity to the great superincumbent pressure, while the outer crust would owe its solidity to having become cool through radiation, while the fluid substratum would remain in that condition because it would not be submitted to sufficient pressure to render it solid, while it would retain sufficient heat to render it molten. As to the density, von Waltershausen has calculated that the density at the centre of the earth is 9.59, under a pressure of 2,500,000 atmospheres, and he thinks it probable that the magma beneath the outer crust consists of felspathic materials, passing lower down into

augitic, and finally at the centre into a magnetic magma.

The next problem to be discussed relates to the manner in which the heat and the gravitation of the earth have produced the elevations and depressions and puckerings of the surface. To explain this it is generally thought that, as the cooling of the earth proceeded, the interior retreated from the solidified crust, and that the latter became crumpled and contorted by the lateral pressure. The author has calculated that the pressure available for this purpose would be equal to that of a column of rock of the surface density, having the same section as the stratum, and 2,000 miles in length—a pressure equal to 830,200 tons on the square foot, and more than sufficient to perform the operations assigned to it.

Volcanic eruptions probably arise from liquid masses of the substratum gaining access to the surface, and we must conceive that the water which accompanies all volcanic phenomena must be present in the magma of the substratum. "We may look upon the state of ignevaqueous solution," observes the author, "as one in which the water-substance is in a gaseous state, and the combination between the water-substance and the rock is probably of that kind, which has been termed 'occlusion' of gas by a liquid. An examination of the amount of contraction which would have produced the existing inequalities of the earth's surface shows that the ocean basins are not the result solely of depressions in the upper surface only of a crust of uniform density, but that they are due to the greater density and general depression of the sub-oceanic crust.

According to the author, volcanic energy is the cause of the compression of the earth's crust. Thus he reverses the theory of Mallet, which makes volcanic energy the result rather than the cause of compression, and he shows that the utmost conceivable amount of heat capable of being obtained by this theory is inadequate to the purpose assigned to it. He considers, moreover, that the geographical distribution of volcanoes is better explained on the supposition of a third crust and fluid substratum than upon any other.

"Their linear arrangement points to their being situated along great systems of fissures: and such systems of fissures are indicative of a thin crust. Fissures which run for long distances in nearly straight courses point either to a movement perpendicular to the fissured surface, or else to a rending pressure within the fissure itself; while, on the other hand, fissures which are caused by contraction in a direction parallel to the earth's surface would divide up an area into polygonal fissures. The former arrangement of the fissures accords best with the distribution of volcanic ranges and suggests a thin crust."

Volcanic regions are either oceanic or appertaining to the coast, and it is probable that the latter are closely connected with elevations of the continents which they skirt, while the oceanic volcanoes are not concerned with true elevatory action. The great volcanic chain of the Pacific approximately divides the earth into two parts one of which contains the chief proportion of land, while the other contains Australia and nearly all the ocean. And perhaps the area of Australia has been elevated within the ocean hemisphere on account of the deflection of the great Pacific line of action by the north-west line, which passes through Sumatra and the Malay Archipelago, and which meets it at the south-east corner of Asia

Although many of the subjects discussed by Mr. Fisher must remain open questions until we are far better acquainted with the conditions of volcanic action, we think that he has cleverly argued his points, and, by the frequent application of a rigid mathematical treatment, has removed his opinions from the domain of those pure speculations which are too often applied to the explanation of obscure phenomena connected with the physics of the earth."

Mr. Gill of the Cape Town observatory, says: "on Sept. 17th at 4^h 50^m 58^s, the great comet was seen and followed right up to the sun's limb where it suddenly disappeared at the time named."

THE COMPUTATION OF A PARABOLIC ORBIT.

I.

It is the purpose of these articles to show the methods of computing a parabolic orbit for a comet. This is easier to compute than an elliptic orbit, and one who is fairly expert can do it in 5 hours time: it therefore offers to inexperienced computers a delightful field in which to exercise their powers.

Mysterious and wonderful as the power to predict the motions of comets seems even to educated people, the writer ventures to assert that the task is within the ability of any one who has had a fair college course in mathematics, and whose knowledge of the elements of trigonometry, and of the use of logarithms is good. Of course extra study would be necessary to understand the *meaning* of the formulas, but a computer can use the formulas, though he does not understand the significance of them all.

The inexperienced computer must pay special attention to the formulas for the trigonometric functions of $(90^\circ+y)$, $(180^\circ+y)$ and $(270^\circ+y)$. Thus having given log tan $A=9,64352n$ (the letter n signifying that tan A is negative) the computer knows that A is either in the second or fourth quadrant. The algebraic sign of sin A or cos A can always be determined by other considerations, and then the computer must be able to find the value of A with unerring accuracy. If sin A be positive in the preceding case, $A=156^\circ\ 14'\ 50''$; if sin A be negative, $A=336^\circ\ 14'\ 50''$.

Logarithms to four or five places are amply sufficient for computing the preliminary orbits of comets

For five-place work the writer has found Houel's table very handy. (Tables de Logarithmes a cinq Decimales par J. Houel, Gauthier-Villers, Paris). This book contains logarithms of numbers from 1 to 10800, logarithms of trigonometric functions, Zech's logarithms for addition and subtraction, three and four place tables of logarithms of numbers, besides many subsidiary tables. In the table of trigonometric functions log sin, cos, tan, cot, sec, and cosec are given for each minute, with proportional parts for seconds.

Newcomb's five-place tables (recently published by Henry Holt & Co.,) are very convenient, but the writer is not certain of their accuracy, since he has not tested them by a prolonged computation. The introduction contains a variety of useful matter including a fine discussion of the subject of interpolation.

In using four-place logarithms of the trigonometric functions, the computer is advised to employ a five-place table, and express the angles to the tenth of a minute, or if the utmost accuracy is not desired, the nearest minute or half-minute will suffice; numbers should be carried to four significant figures. If five-places be used, the angles should be carried to seconds, or hundreths of a minute; numbers should be carried to five significant figures.

The computer will also need the American Ephemeris and Nautical Almanac, or some equivalent work.

We proceed to the computation of the orbit. Three observations are selected, the interval of time between the first and second observations, being about the same as the interval between the second and third; this is necessary to get a good orbit. The published observations give the observed right ascension and declination of the comet, and the local mean time, at which each observation was made. Since nothing definite is known of the distance of the comet from the earth, we cannot correct the observations for aberration or parallax, and it will not be advisable to reduce the right ascension and declination from apparent to mean place. The writer will explain in another article the method of making these reductions.

The computation of the orbit of comet Finlay might trouble a beginner somewhat, on account of its close approach to the sun; even so experienced a computer as Mr. CHANDLER has found difficulty in making his orbit satisfy the observations well, as will be seen by reference to *Special Circular* No. 28 of the SCIENCE OBSERVER. Let us therefore take the great comet of 1881. The following are the observations: The first two were made at Chicago, and the third at Washington. The first two observations, though rough are sufficently accurate for our purpose.

1881. Date.	Local. Mean Time	Apparent. Right Ascension.	Apparent. Declination.
June 23	$15^h\ 23.6^m$	$5^h\ 36^m\ 20^s$	46° 48′
" 25	8 57.9	5 43 30	53 51.5
" 26	11 27.0	5 48 38.4	57 40 52″.

We first reduce all the time to Washington mean time, and then change those to decimals of a day. The right ascension is reduced to arc, the apparent obliquity of the ecliptic (ε) is taken from the almanac; the longitude of the sun (L) and the logarithm of the earth's radius (R) are interpolated from the almanac, for the three dates. We now have:

1881 Washington, M. T.	α	δ
June 23.6707	84° 5.0′	46° 48′
June 25.4028	85° 52.5′	53° 51.5′
June 26.4771	87° 9′ 36″	57° 40′ 52″

L	$\log R$	ε.
92° 56′ 16″	0.00715	
94° 35′ 24″	0.00718	23° 27′ 16″
95° 36′ 53″	0.00719	

We have now to reduce the right ascension and declination to celestial longitude and latitude. This work is carried to five decimal places and must be done with scrupulous care, since any error made here will not be discovered in the subsequent computations. The formulas can be found in Oppolzer's Lehrbuch zur Bahnbestimmung der Kometen und Planeten, Vol. I, p. 14. λ and β denote the longitude and latitude of the comet, and N is an auxiliary angle, introduced to shorten the computation.

$$\tan N = \tan \delta \operatorname{cosec} \alpha.$$

$$\tan \lambda = \cos (N-\varepsilon) \sec N \tan \alpha.$$

$$\tan \beta = \tan (N-\varepsilon) \sin \lambda$$

The quadrant in which N lies is determined by the fact that $\sin N$ has the same sign as $\sin \delta$; the quadrant of λ is determined by the fact that $\cos \lambda$ has the same sign as $\cos \alpha$. For a check, to test the accuracy of the computation we may use the formula.

$$\cos (N-\varepsilon) \sec N = \cos \beta \sec \delta \sin \lambda \operatorname{corsec} \alpha.$$

Below is the computation in full.

	June 23.6707	25.4028	26.4771.
Date	June 23.6707	25.4028	26.4771.
α	84° 5.0′	85° 52.′5	87° 9′ 36″
δ	46° 48′	53° 51.′5	57° 40′ 52″
ε	23° 27′ 16″		
log tan δ	0.02731	0.13648	0.19884
log sin α	9.99768	9.99888	9.99947
log tan N	0.02963	0 13760	0.19937
N	46° 57′ 12″	53° 55′ 42″	57° 42′ 45″
$N-\varepsilon$	23° 29′ 56″	30° 28′ 26″	34° 15′ 29″
log cos $(N-\varepsilon)$	9.96240	9.93544	9.91725
log sec N	0.16584	0.23004	0.27232
log tan α	0.98450	1.14195	1.30445
log tan λ	1.11274	1.30743	1.49402
λ	85° 35′ 21″	87° 10′ 46″	88° 9′ 49″
log sin λ	9.99871	9.99948	9.99978
log tan $(N-\varepsilon)$	9.63828	9.76970	9.83320
log tan β	9.63699	9.76918	9.83298
β	23° 26′ 12″	30° 26′ 39″	34° 14′ 40″
log cos β	9.96261	9.93557	9.91732 Check.
log sec δ	0.16460	0.22930	0.27194 Check.
log sin λ	9.99871	9.99948	9.99978 Check.
log cosec α	0.00232	0.00112	0.00053 Check.
log cos $(N-\varepsilon)$ sec N	0.12824	0.16547	0.18957 Check.

The check-values of log cos $(N-\varepsilon)$ sec N agree well with those obtained by adding log cos $(N-\varepsilon)$ to log sec N and we therefore proceed, collecting the fundamental data below.

T'	June 23.6707	λ'	85° 35′ 21″
T''	" 25.4028	λ''	87° 10′ 46″
T'''	" 26.4771	λ'''	88° 9′ 49″
L'	92° 56′ 16″		
L''	94° 35′ 24″	β'	23° 26′ 12″
L'''	95° 36′ 53″	β''	30° 26′ 39″
log R'	0.00715	β'''	34° 14′ 40″
log R''	0.00718.		
log R'''	0.00719.		

The method employed will be the usual one (Olbers' method) and the formulas used may be found on pages 346 and 347 of Vol. I of Oppolzer. There is however another method which frequently gives more accurate results, and its explanation may be found on pages 133-140 of the same work.

Olbers method is explained on pages 121–132.

NOTES ON THE GREAT COMET OF 1882.

E. E. BARNARD.

The following is the gist of my notes of the great comet of 1882, clouds having prevented earlier work:

Sept. 22. To the naked eye this morning, the tail was very bright, straight and slender, about 12° long: head and nucleus rather foggy. The outline of the train for its whole length is brighter than its inner part and is about 1½° broad at its widest part. In the telescope the nucleus is blurred, resembling a ball of diffuse light seen through haze. A bright outline passes completely around the head, forming a parabolic curve of yellowish light which streaming backward traces the boundary of the tail. The nucleus is not placed within the head, as in the great comet of last year, but lies on and makes part of its margin. A bright path of light is visible in the head *n. p.* the nucleus, and a dark channel behind the nucleus. The image is unsteady. The comet is seen by the naked eye at 5^h 55^m as a hazy speck of light in the presence of strong sunlight. At 6^h 20^m the nucleus is still plainly visible in the telescope, showing a faint brush of light on each side. It appears to be bright enough to be followed during the entire day with the telescope.

Sept. 23, a. m. The axis of the train less bright than other parts from its extremity nearly to the nucleus as seen by the naked eye. Train, about 15° long, slightly convex toward the south, broadest part 1½° wide. The south side is the brightest and best defined. In the telescope, nucleus very bright, but diffuse.

Sept. 24, a. m. Inner part of the tail darker, the edges bright and clearly defined. Telescopic view unsatisfactory. Nucleus smaller probably, the rim or margin around the head not so bright, but very much thicker.

Sept. 27, a. m. The margin of the head still thicker and less bright. The nucleus is elongated in the direction of the tail.

Oct. 1, a. m. The southern side of the train well defined

and bright, the northern side much less so. The whole comet is a grand sight. In the telescope the nucleus is slightly more elongated, the head narrow and clearly defined.

Oct. 4, a. m. The nucleus is six or seven times as long as it is broad, and is inclined to the axis of the tail about 5°. A dark channel appears behind the nucleus near the middle of the head resembling a shadow of the nucleus. A faint, but well defined envelope, fifteen minutes in diameter, surrounds the head. The extremity of the train is shaped like the tail of a fish.

Oct. 5, a. m. More hazy light about the nucleus than before, dark channel still seen, envelope seems to be nearer the nucleus than yesterday, nucleus much more elongated and separated into three unequal parts. If we call preceding part (western) (1), the middle, (2), and the following part (3), (1) is a strip with faint indications of brakes in it, slightly brighter at its following end; (2) is a star-like form as seen through haze; and (3) is like (2) only brighter and smaller. The separations of the nucleus are plainly seen. Powers used were 78, 104, and 173.

Oct. 6, a. m. Nucleus about the same, (1) larger, less bright than (2), ends brighter than the middle, each being made up of two tiny stellar points; (2) as yesterday, (3) dim, not well seen. Faint channel still seen, the large envelope has dropped back so as to lie very little in front of the head.

Oct. 7, a. m. Coma bright and more of it.

Oct. 10, a. m. Seeing poor, nucleus surrounded by an increased and slightly yellowish coma.

Oct. 12, a. m. Extremity of tail as seen before, longest projection from the southern margin extending 3° or 4°. Whole comet very white. In the telescope, can occasionally see the nucleus broken. Definition poor.

Oct. 13, a. m. High south-west wind, instrument unsteady. The comet is seen to have two short filmy tails pointing *towards* the sun and opposite to the main train.

They are over one degree long, and start from the large train back of the head. They are parallel to each other, and the space between is almost free of cometary haze. Both are

clearly seen, but the northern one is the more distinct. The dark channel is not seen; the head is enormous, filling the whole field of view with a mass of bright pearly vapor, which, in the unsteady view, seems to shine from separate centers, the nucleus certainly being *very* elongated. No description can do justice to the wonderful appearance of the head and its appendages on this occasion.

Oct. 14, a. m. The two short tails seem to be blending, and more cometary haze is seen before the head between them. They still originate in the great train back of the head.

While sweeping to the south of the comet, I 'picked up' a large distinct cometary mass, fully 15′ in diameter. A similar object but less bright was seen close beside this, their edges touching—apparently a double comet—and on the opposite side of the first object was a third fainter mass, the three almost in line, east and west. The third object is distant from the first about half its own diameter. A slight displacement of the telescope toward the south-east revealed a number more of these wonderful objects; one was very elongated in form. There were at least, six or eight of those objects near one another within about 6° south by west of the large comet's head. Their appearance was that of distant telescopic comets with very slightly brighter centers and so near that several were in the field at once. Time was used in sweeping for more, so that no watch was made for motion; but from a rough comparison of a number of small stars in the field it was evident that the brightest object was not moving rapidly. They were found about $4^h 30^m$, and were seen at intervals until daylight obscured them, my wife also seeing them easily.

The discovery of these objects were telegraphed that morning to Professor Swift. A slight haze on the following morning prevented a search for them, and they were not seen again.

(To be continued.)

On November 7, at 19h. 20m. Greenwich M. T., Jupiter was in conjunction with the star 1975 B. A. C., with a difference of only four seconds in their latitudes. The occuation is of interest from its rarity.

WHEN WILL THE COMET RETURN?

The following, besides dealing with the comet, shows how the motion of a body moving in a very eccentric orbit in a given period may be conveniently dealt with.

I have shown in my "Geometry of Cycloids," that the common cycloid may be used for measuring the motion of a body in a very eccentric orbit around the sun—at least this follows directly from what is illustrated there in the plate facing p. 209 where the curves for all orders of motion, from motion in a circle to motion in a straight line, under gravity, are given together. We see in that picture a certain curve for an eccentricity of nine-tenths, and this curve lies very close to the common cycloid representing the time-curve for motion in a straight line (eccentricity unity). How much nearer (in fact, not distinguishable from the cycloid), would be the curve for an eccentricity of .99989 such as the comet of 1843 had. Supposing the period of the comet reduced to one year, the eccentricity, assuming the perihelion distance 500,000 miles, would be

$$\frac{92{,}500{,}000-500{,}000}{92{,}500{,}000}=\frac{920}{925}=\frac{184}{185}$$

Or the distance of focus from perihelion less than one-eighteenth part of that shown in the plate above mentioned Thus the time-curve would lie at only one-eighteenth part of the distance from the cycloid at which the curve for eccentricity $9 \div 10$ is placed, which ye lies so near the cycloid that, if drawn by itself, the eye could not recognise any diffrence from the true cycloidal figure.

We may, then, for the purpose of a rough calculation such as I am about to make, take the cycloid for our time-curve after the manner described in Section VII, of my treatise on the Cycloid (the section explaining my "Graphical Use of the Clycoid and its companion to determine the motion of Planets and Comets").

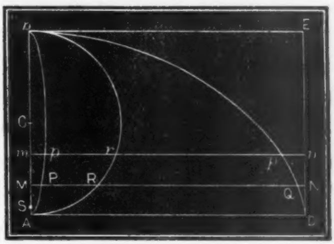
The particular problem I wish now to deal with is this:—

Supposing the comet of 1843, which had been before moving in a period of more than 100 years, moved after

1843 in a period of 37 years, and after 1880 in a period of less than three years, so as to be back at perihelion on Sept. 17th last, we might fairly infer, it would not be at all unresonable to infer that its next circuit would be accomplished in a year. Let us see, then, in what time, roughly it would accomplish any distance from the sun on its elongated orbit.

Let AP*a* represent the orbit of a comet, C its centre, AC =earth's distance, or 92,500,000, S the sun (AS=about 500 000 miles), AQD a half cycloid having *a*A for axis. Then, as I have shown in my "Cycloidal Geometry," if MP QN is drawn parallel to the base AD, the time in which the comet moves from A to P is to the time from A to *a* as QN is to MN.

Now, instead of drawing a cycloid *a*QD, with special care, to give us the times we want, suppose we make the calculations suggested by this construction. They are very easy.



Draw the circle *a*RA cutting MPQN in R. Then we know from the properties of the cycloid that

QN=arc AR−MR.

Suppose now AM=a third of AC: that being about the distance traversed by the new comet from S, as observed on Sept. 24.

Then CM=⅔ CA=.66666 . . . if CA=1; then from a table of natural cosines we find that arc AR, whose cosine is ·666 . . . is one of 48° 12′; and (this we take out at the same time) the sine of this arc is ·745476. Turning next to a table of lengths of circular arcs, we find that the arc

AR of 48° 12′ has a length of ·841249. Hence

$$QN = \cdot 841249 - \cdot 745476 = \cdot 095773$$

$$\text{And } AD = \text{semi-circumference} = 3\cdot 141593.$$

Thus the time from A to $P = \frac{95773}{1570796}$ of half a year

$$= \frac{95773 + 182\cdot 625}{3141593} \text{days.}$$

$$\begin{array}{lr} \text{log.} & 95773 = 4\cdot 9812431 \\ \text{log.} & 182\cdot 625 = \underline{2\cdot 2615602} \\ & 7\cdot 2428033 \\ \text{log.} & 3141592 = \underline{6\cdot 4971499} \\ & 0\cdot 7456534 = \text{log. } 5\cdot 5674. \end{array}$$

So that on this supposition as to the period 5 days 13 hours 37 minutes would have been required to carry the comet over the distance actually traversed between Sept. 17 and Sept. 24, or in 7 days.

Let us try an orbit of different dimensions:—

Suppose A*a*, the major axis, to be only one-half the earth's, so that by Kepler's Third law the period, instead of being one year would be 1 year $\div 2^{\frac{3}{2}}$, or $1 \div \sqrt{8}$ (we need not work out this value—as we shall obviously want the logarithm of the number of days in this new period and this will be obtained by subtracting the logarithm of $\sqrt{8}$ from the logarithm of 182·625 already in use).

If now A*m* represent about a third of the earth's mean distance on this new scale, where AC represents half the earth's distance, then obviously $Am = \frac{2}{3}AC$; and $\frac{Cm}{AC} = \frac{1}{3} = \cdot 3333$. . . . . Hence A*r* is an arc of 70° 32′; $rm = \cdot 942835$ (using table of natural sines as before); and arc $rA = 1\cdot 231039$. Thus

$$qn = 1\cdot 231039 - \cdot 942835 = \cdot 288204.$$

or time

$$\text{from A to } p = \frac{288204}{3141593} \text{ of } \frac{1}{\sqrt{8}} \text{ of } 365\cdot 25 \text{ days.}$$

Now,—

log 288.204=5·4597000	$\frac{1}{2}$ log 8 =0·4515450
log 182.625=2·2615602	log 3141593=6·4971499
7·7212602	6·9486949
subtract 6·9486949	

0·7725653=log 5·9233

This is still too small; so that if we are right in concluding from the observation at Vienna on September 24, that on that day at noon the comet had reached the position shown at *d*,* Fig. 1, p. 327, the projection of which, S*m*, on the axis, *pk*, is about one-third of SD, then the period in which the comet will return to perihelion is certainly less than half a year. It is, however, to be noted that in that case the orbit has been reduced in width (minor axis), so that some such point as *d'* would be the true position of the comet on September 24, the projection of which, S*m'*, on *kp* is rather less than S*m*.

For my own part—so far as observations hitherto made enable me to judge—I expect the comet back in less than half a year.—PROCTOR IN *Knowledge*.

The following elements of GOULD'S comet by Mr. MORRISON of the Nautical office, Washington, D. C., by oversight were omitted or they would have appeared in last month's issue:

ELEMENTS.

T	Sept. 17.0881 Wash. M. T.	
☊	345° 17′ 19.″2	nox 1882.0
ω	292 47 24. 2	nox 1882.0
i	38 20 4′.7	
log q	7 78232	
Motion	retrograde.	
log Δ	0.04555	
log Δ'	0.06510.	

*The reference is to a figure showing the orbit of the comet, *d*, comet's position, S D distance of the earth from the sun, *p k* is perpendicular from the comet on the axis of its orbit, S*m* is the projection of the orbit from *d* on its axis.—Editor.

EDITORIAL NOTES.

The great comet is still the wonder of every beholder on account of its magnitude and its continuing brightness. As one ought to expect it is growing fainter to the naked eye, and, in the telescope, its physical changes are less and less marked as its distance from the sun and from the earth increases. During the last month the comet has twice changed its name. It was first announced as discovered by Dr. CRULS of Rio Janeiro, Sept. 10; then it was claimed by Mr. FINLAY, assistant at the Cape of Good Hope observatory, and finally it appears that Dr. B. A. GOULD, of Cordoba, S. A. saw it Sept. 5, and hence it shonld be called GOULD's comet. December 1, the comet will be about 140 millions of miles from the earth and 180 millions from the sun. It is moving from the sun more than twice as rapidly as from the earth. This is why it grows faint slowly although receding from the sun at the rate of more than one million of miles daily.

At Cape Town observatory, Africa, Mr. Gill writes that two observers with separate instruments, followed the comet Sept. 17, right up to the sun's limb where it suddenly disappeared at 4^h 50^m 58^s Cape mean time.

We are not aware that the history of comets contains any other observation like this. To be seen at all, the comet must have been exceedingly bright. This might be expected on account of its near approach to the sun, and the resistance it must meet while passing through the sun's outer atmosphere according to Mr. PROCTOR at the rate of 340 miles per second! When the comet was last seen it was only 1^h 35^m before its perihilon passage as given by Dr HIND's elements

Another curious feature was the behavior of the nucleus and the coma, as given last month by Professor YOUNG of Princeton Professor SMITH of Lawrence, and Professor WILSON of Cincinnati. Mr. BARNARD, of Nashville, has also kindly favored the MESSENGER with full notes, (elsewhere given in this issue) noticing these great physical changes among other things. The dark channel along the axis of the tail and behind the nucleus is evidence that the tail is tubu lar. The curvature of the tail is in the direction it should be, if caused by the motion of the comet only. Whether it should be more or less curved if this be the only cause, we can not say. At the present time the tail stands nearly at right angles to the path of the nucleus, and as the comet is moving southward its southern or brighter side is foremost, which probably favors equally well either the material or the electrical theory for the formation of the tail; but it is difficult by either theory alone to explain why the train was so evenly bright or well defined to its extremity in the later observations as well as the earlier. This feature is especially interesting.

Much has been published during the last month respecting the

identity of this comet with that of 1668, 1843 and 1880. Most astronomers, though not all, think they are one and the same. Some think also that this comet will fall into the sun because at each return it seems to be coming nearer and nearer to his surface. If at any time this menacing body shall come within 400,000 miles ot his surface, the probability is great that it would quickly fall into the sun, unless broken and scattered in fragments by forces at play on, or within its nucleus In view of its lessening perihelion distance (which is claimed by some computers,) Mr. Proctor thinks that the comet will return within one year, and, in the course of a few years end its career in the way already indicated. If all these things should take place at any time, there would be no cause of alarm respecting the physical effect on the earth. That would doubtless be scarcely appreciable by any means. It is very doubtful it astronomers would be apprised of the fact in other ways than by noticing a loss of the comet, or, in favorable circumstances observing a disturbed condition of the solar surface coincident with the time of disappearance.

There are prominent American astronomers who hold well supported views quite the contrary to these. Prof. DANIEL KIRKWOOD is one whose mature and careful opinion always commands respect. Recently he says:

"Prof. CHANDLER's latest elements, deduced from observations taken since the perihilon passage, assign the comet a period of eight years and six months—more than three times the interval between the appearances of 1880 and 1882. This result is, therefore, unfavorable to the theory of identity with those of 1668 and 1843. But even granting that the four apparitions were returns of the same body, do the facts of observation indicate the early termination of the comet's orbital motion? The perihelion distances of the four comets were as follows:

	Miles.	Computor.
Comet of 1868....	0.0047=437,000	Henderson.
Comet of 1843....	0.0055=512,000	Hubbard.
Comet of 1880....	0.0067=623,000	Tebbutt.
Comet of 1882....	0.0088=818,000	Chandler.

The shortning ot the period is, therefore, attended by an increase of the perihelion distance which would mean less resistance at each successive return.

Again, comets which approach very near the sun are, for obvious reasons, more liable than others to be separated into parts by the sun's disturbing influence. The indications of this process in Finlay's comet have been observed by several astronomers, and its gradual disintrigation is highly probable. The dissevered fragments would not all move with exactly the same velocity. They would, therefore become diffused around the orbit, so that in case of ultimate precipitation upon the sun, the collision would be a very slow process—the fall merely of finely-divided meteoric matter."

The spectrum of this comet has been so bright that it could be studied in full daylight successfully. M. THOLLON found that its leading characteristic was the presence of the bright lines of sodium. He saw a tolerably distinct spectrum due to the scattered light of the atmosphere in which the Fraunhofer lines were distinguishable, and upon this a narrow and more brilliant continuous spectrum, given by the nucleus of the comet, was seen clearly detached. From the height of the spectrum the nucleus was thought to be about 15″ in diameter. The spectrum reached far into the violet. The sodium lines were produced both by the nucleus and the neighboring regions, and were estimated to have an apparent diameter of 15′. They were narrow, perfectly separated, and exceedingly bright. Mr. THOLLON ascertained that the bright lines of the comet were not exactly superposed on the Fraunhofer lines, but were both displaced toward the red by a very small amount, the same in each case which showed that the comet was traveling away from the earth at that moment. No part of the comet showed the carbon bands, nor any band or line other than those of sodium, perhaps on account of the diffuse light which would be able to mask bands of small brilliancy.

This comet and the comet Wells, which appeared a few months ago, are the only ones that have shown the spectra of sodium lines. This is thought to indicate increased stability and mass in the nucleus. Various other interesting inferences might be drawn from these facts and many others at hand which may be further considered at another time.

A. N. SKINNER, assistant Astronomer in charge of the transit circle, naval observatory, Washington D. C. sends the following meridian observation of GOULD's comet of this year, made on the transit circle Nov. 16, by assistant astronomer WINLOCK:

1812 Nov. 15.74 R. A. $9^h\ 27^m\ 50.^s72$
N. P. D. 114° 49′ 18.″9

The part observed was the main point of condensation, near the following end of the nucleus. The observation is corrected for refraction but not for parallax.

Respecting the probable times of the four contacts in the coming transit of Venus. Professor S. NEWCOMB has published the following in recent European journals.

"The comparison of different tabular times of contact of Venus with the Sun, given by Dr. Hilfiker in No. 2448 of the 'Astronomische Nachrichten,' suggests the completion of the comparison by adding the predictions of the American Ephemeri together with the probable actual corrections to the times. It is to be remarked, however, that these times are derived, not from the tables of Le Verrier, but from Hansen's tables of the Sun and Hill's tables of Venus. The following are the tabular times of the principal phases thus obtained to

which are appended the times from Le Verrier's tables These are the means of the two results from the 'Nautical Almanac' and 'Berliner Jahrbuch,' which are adopted because these means correspond closely to Bessel's semidameter of the Sun, which is adopted in the American Ephemeris:—

			G. M. T. h m s	Le Verrier. h m s
Contact I.	begins	Dec. 6.	1 48 32·3	
	geocentric		1 56 11·3	1 55 32
	ends		2 3 57·0	
Contact II.	begins	Dec. 6,	2 9 1·7	
	geocentric		2 17 2·4	2 15 51
	ends		2 25 14·2	
Contact III.	begins	Dec. 6,	7 45 39·7	
	geocentric		7 53 51·5	7 52 19
	ends		8 1 52·7	
Contact IV.	begins	Dec. 6,	8 6 56·2	
	geocentric		8 14 42·5	8 12 39
	ends		8 22 19·8	

To estimate the corrections which will probably be required, both to these times and to those of the other ephemerides, we remark that the following corrections to the right ascension and declination of Venus relative to that of the Sun were derived from the American photographs of 1874 by Mr. D. P. Todd (Am. Journal of Science. June 1881):—

$\triangle\ (\alpha-\alpha') = +1''\cdot 12;$ $\qquad\triangle(\delta-\delta') = +2''\cdot 08.$

As the tabular errors tend to increase with time, these corrections will probably be one-fifth greater in 1882, which will make them as follows:—

$\triangle(\alpha-\alpha') = +1''\cdot 3;$ $\qquad\triangle(\delta-\delta') = +2''\cdot 5.$

On the other hand a comparison of the Ephemerides in the 'Nautical Almanac' with the American Ephemeris shows the following corrections to be applied to the positions of Venus and the Sun derived from Le Verrier's tables to reduce them to the tables of Hill and Hansen respectively:—

$\triangle\alpha = +\ 5''\cdot 9,$ $\qquad\triangle\delta = +0''\cdot 9,$

$\triangle\alpha' = -\ 0''\cdot 2,$ $\qquad\triangle\delta' = +0''\cdot 3.$

We conclude therefore that the corrections will probably be required to the relative positions of Venus and the Sun given by Le Verrier's tables are:—

$\triangle(\alpha-\alpha') = +7''\cdot 4;$ $\qquad\triangle(\delta-\delta') = +3''\cdot 7.$

The following are the resulting corrections to the four times of contact:—

	s.		h. s. m.	
Contact	I. + 20,	whence	I. = 1 55 52	G. M. T.
Contact	II. + 13	"	II. = 2 16 4	"
Contact	III. +153	"	III. = 7 54 52	"
Contact	IV. +145	"	IV. = 8 15 4	"

AN UNRECORDED COMET.

In the Syriac Chronicle of Joshua the Stylite, of Edessa, composed A. D. 507, there appears to be a notice of a comet unknown hitherto to astronomical publications. This Chronicle exists in manuscript in the Vatican Library at Rome, being preserved by being incorporated into the larger work of Dionysius of Tell Mahre. The extant manuscript itself was written at some time between A. D. 907 and 944; probably before 932. The best edition of this Chronicle is that published by Prof. William Wright, of Cambridge, England; elegantly edited, and with an elegant English translation.

The notice of the comet comes under the year 811 of the Seleucian era, which corresponds to A. D. 499-500, from October to October. The notice reads: "Again in the latter Kanun [January], we saw another sign in the exact south-west corner of the heavens [literally, on the south and west, in the very corner], which resembled a spear. Some people said of it that it was the besom of destruction, and others said that it was the spear of war."

The chronist, who is a devout Christian, and sees in war and pestilence only the chastisement for sins, and in history only a warning to future generations, relates this as one of the signs of the war between the Persians and Byzantine Greeks, which occurred A. D. 502-506, in the upper Mesopotamian valley. The marks of care and accuracy are visible throughout the whole of the Chronicle; and of most of the events the chronist himself was an eye-witness. He wrote at the request of Sergius, priest and abbot; and his work is entitled: "A History of the Time of Affliction at Orrhai [Edessa] and Amid [Diyar Bekr] and throughout all Mesopotamia." H. H.

From late calculations it seems very probable that the orbit of GOULD's great comet of 1882 is an ellipse of accentricity differing but little from the parabola. Another approximation, by Mr. S. C. HANDLER of Cambridge gives the following elements:

$$T = \text{Sept. } 17.2304. \quad \text{Greenwich M. T.}$$

$$\left.\begin{array}{rrrr} & \circ & ' & '' \\ \pi = & 55 & 12 & 41.2 \\ \omega = & 69 & 22 & 7.2 \\ \Omega = & 345 & 50 & 34.0 \\ i = & 141 & 54 & 56.2 \end{array}\right\} 1882.0$$

$$\log. q = 7.8835636$$
$$e = .9999700$$

CONSTANTS FOR THE EQUATOR. (1882.0).

$$x = r\,[9.9950007] + \sin\,(170^\circ\ 35'\ 53.8'' + v)$$
$$y = r\,[9.9876224] + \sin\,(262^\circ\ 42'\ 59.4'' + v)$$
$$z = r\,[9.4465116] + \sin\,(\ 48^\circ\ 59'\ 30.2'' + v)$$

A comparison of this orbit with observation on October 30, gives

$$(C\text{—}O). \quad \Delta\alpha = -1.12^s$$
$$\Delta\delta = -17.''$$

The following ephemeris computed from the above elements, may be useful for the comparison of observations:

EPHEMERIS.

Greenwich noon.		—R.A.— h. m. s.	—Decl.— ° ′ ″	Log. Δ.	Log. r.	Light
Dec.	1.	8 49 33.96	− 28 41 59.6			
	3.	43 44.56	29 4 42.3	0.182926	0.296243	.46
	5.	37 46.49	29 24 58.1			
	7.	31 40.65	29 42 39.0	0.186812	0.310991	.42
	9.	25 28.25	29 57 38.1			
	11.	19 10.40	30 9 49.2	0.191740	0.325027	.38
	13.	12 48.40	30 19 7.3			
	15.	8 6 23.73	30 25 29.2	0.197822	0.338411	.35
	17.	7 59 57.98	30 28 53.0			
	19.	53 32.66	30 29 19.1	0.205138	0.351206	.32
	21.	47 9.31	30 26 49.4			
	23.	40 49.38	30 21 26.8	0.213708	0.363458	.29
	27.	28 25.62	30 2 23.4	0.223524	0.375213	.26
	31	7 16 31.79	—29 33 1.8	0.234535	0.386508	.24

Professor H. A. Howe of the University of Denver, Colorado, has completed elements of the orbit of the great comet, on the assumption that it is an ellipse, using the Washington observation of Sept. 19, and the Cambridge observations of Sept. 30, and Oct. 9, as the necessary data. These elements are referred to the apparent ecliptic and equinox of Sept. 30, 1882. The observations were corrected for parallax and aberration.

ELEMENTS.

$$
\begin{aligned}
T &= \text{Sept. } 16.9935. \quad \text{Washington M. T.} \\
\pi &= 56^\circ \; 6' \; 25'' \\
\Omega &= 346 \; 11 \; 38 \\
i &= 142 \; 3 \; 14 \\
\omega &= 69 \; 54 \; 47 \\
\log q &= 7.90516 \\
\log e &= 9.99998
\end{aligned}
$$

$$
\text{Obs.—Comp} \begin{cases} \delta'\lambda'' \cos\beta'' = -1'' \\ \delta'\beta'' = -6'' \end{cases}
$$

The agreement of the obove elements and those recently computed by Mr. Chandler is very close. It is noticable that the eccentricity is practically unity in both computations.

Professor I. Sharpless, of Haverford College, Pa., sends the following interesting note respecting Gould's comet:

"On the morning of October 15, I distinctly saw the haze around

comet B, 1882, spoken of by Professor SMITH in the last number of the SIDEREAL MESSENGER. It would readily escape detection in a large telescope, as it would occupy the whole field. In our $8\frac{1}{4}$ inch reflecting comet-seeker, with a field of $1\frac{1}{4}°$, the boundries were very distinctly seen. The breadth through the nuecleus was about one degree. The boundary line did not look like a parabola, but like arcs of two circles which if continued would intersect, in a line between the nuecleus and the sun, and about a degree from the former,—portions of two great eccentric envelops."

"The figure is a copy of one made at the time. The outer lines indicate the boundaries of the haze. The portions dotted could not be followed in the telescope." [If our engraver had followed copy, portions of the upper third of the curved and the straight lines also, would have been dotted lines. The copy was plain]. "This haze is not I think 'the stripe of faint light', which Professor YOUNG describes as 'extending towards the sun to a distance of 4°,' which was also seen in the binocular, and was no broader than the portion of the tail visible to the naked eye. The position of the stripe is indicated by the straight dotted lines. Its outlines were not definite in the telescope, and the reason we could not follow the latter to the vertex may have been that it was lost in the light of the stripe."

The following note from Professor YOUNG, of Princeton, was too late for last month's use; we gladly give it place now:

"The two places of the comet observed at Princeton on September 19th and 20th, were given erroneously in the October number. A new reduction makes them as follows:

Princeton M. T.			h	m		
1882	Sept.	19	0	36·25	{	α $11^h\ 20^m\ 19.5^s \pm 0.^s5$ $\delta + 0°\ 12'\ 25'' \pm 5''$
1882	Sept.	20	1	16.00		$\delta - 0°\ 38'\ 10'' \pm 10''$
"	"	20	1	28.00		α $11^h 13^m\ 50.7^s \pm 1^s$

The sidereal clock time was accidently given as Princeton mean time for the observation of the 19th, and on the 20th the refraction was applied to the R. A. with the wrong sign. There were also other slight errors in the rough reduction."

PARALLAX OF THE STAR BRADLEY 3077.

Dr. GYLDEN has lately published the results of his micrometric comparisons of this star with neighboring ones, his memoir gives the parallax as

$$0''.28 \pm 0''.045$$

Professor BRUENNOW found by a similar method the parallax to be

$$0''.07 \pm 0''.02$$

In this connection a recent paper by Dr. BACKLUND of Pulkowa is interesting as it gives the reduction of some observations begun by Dr. WAGNER on the same star. These observations were made by means of differences of R. A with the transit instrument, and they were discontinued as the comparison stars were too faint to observe during the whole year. From the incomplete series Dr. BACKLUND has obtained the following results:

Twenty-seven comparisons with star *a* give

$$+0''.20 \pm 0''.080$$

Thirty-two camparisons with star *b* give

$$+0''.21 \pm 0''.078$$

This star has thus a small parallax.

THE M'CORMICK OBSERVATORY OF THE UNIVERSITY OF VIRGINIA.

Warner & Swazey of Cleveland have completed arrangements with the director of the observatory Professor O. STONE, by which they are to build a 45 foot iron and steel dome to contain the 26¼ inch Clark refractor.

The dome is to turn on a live ring, on Grubb's plan, but the rolls are to be mounted in an ingenious manner which does away with most of the friction and allows of the most accurate placing of the ring on the track. It is guaranteed that the dome (45 feet) will revolve with a direct pressure of fifty pounds.

NEW STAR OF 1848.

($16^h\ 52^m\ 47^s$; $-\ 12°\ 42'$; 1880.0)

The magnitude of this star was estimated as between 12.5 and 13.0 on July 18, 1882, at the Washburn Observatory. This is sensibly the same as the last printed estimate (by Dr. SCHMIDT of Athens) which was made in 1875.

SCHROETER's observations of *Mars*.—The University of Leyden having acquired in 1876 the manuscripts and copper plates of SCHROETER's great unpublished work on *Mars*, "Areographische Beitrage zur genauern Kenntniss und Beurtheilung des Planeten *Mars*," Professor BAKHUYSEN is about to bring it out. SCHROETER had all but completed it at the time of his death, and had indeed, it would appear, thoroughly revised the greater portion of it. Professor BAKHUYSEN states that having reduced SCHROETER's observations for the position of the axis of *Mars*, he finds its longitude 352° 59′ and the latitude 60° 32′.

B. A. C. 7424

R. A. 21^h 15^m 32^s; Dec.−23° 23′ 10″; 1850.

This star has had magnitudes assigned to it as follows:

Lacaille, 8802, 7; Piazzi No. 97, 7.8; Mayer 880, 8;
Lalande 41540, 7; Taylor iii 2679, 6.7; Wash. Mu. Z.
183, 8.9; Wash. Mu. Z. 192, 8.7; Wash. Me. C. Z. 148, 5;
Argelander, S. Z., 21353, 7;
Lamont 718, 6.7;
Yarnall 9341, 5.7 (2 obs.);
Stone 11339, 7.

It is noted brighter than 7.0 by four observers, and fainter than 6.9 by eight observers.

E. S. H.

By kindness of Professor E. Frisby of the Naval observatory, Washington, D. C. we are able to give the following list of important observations on Gould's comet. Corrections on those previously published are made in the R. A. of Sept. 19.1, Sept. 20.9 and Oct. 9.7.

OBSERVATIONS.

Date	Wash M T h m s	App. R. A. h m s	Appt Dec. ° ′ ″	Obs.	Observed with
Sep. 19.1	2 45 21.8	11 19 38.17	+ 0 7 34.6	F	Sun and Circles.
19.8	18 43 2.5	11 15 22.11	− 0 26 14.7	F	*a* Leonis and Circles.
19.9	on merd'n	11 14 18.94	− 0 34 28.5	W	Transit Circle.
20.9	on merd'n	11 9 10.97	− 1 19 21.1	S	Transit Circle.
23.7	18 3 45.1	10 58 16.0	− 3 10 30.5	S	*a* Hydræ and Circle.
29.7	17 22 18.9	10 43 4.25	− 6 29 15.4	F	*a* Hydræ and Circle.
Oct. 1.7	17 30 30.6	10 39 14.66	− 7 29 10.5	F	*a* Hydræ and Circle.
6.7	17 27 6.5	10 31 1.55	− 9 47 51.4	F	W.X 515=La 753.
8.7	17 17 25.7	10 28 6.53	−10 40 21.9	F	W.X 472=La 742
9.7	17 25 56.4	10 26 40.64	−11 6 25.2	E	W.X 437
14.7	17 1 17.1	10 18 53.08	−12 37 38.2	E	W.X 282
24.7	17 44 49.5	10 5 52.29	−17 5 6.8	F	O. Args 10429 & 10430

Oct. 24.7 was observed with the twenty-six inch equatorial and the comparison star was quite near. The parabolic elements and coordinates previously sent and published are still very close,—quite near enough for distance from the earth for computing aberration and parallax.

OBSERVATIONS OF BARNARD'S COMET MADE AT THE U. S NAVAL OBSERVATORY, WASHINGTON.

[Communicated by Vice-Admiral S. C. Rowan, Superintendent.]

Date	Wash.M.T.	App. *a*	App. Dec.	log △ p	log △ p	Comp. Star
1882	h m s	h m s	° ′ ″	s	″	
Sept. 18	16 33 57.1	7 27 24.06	+12 40 54.6	9.7252*n*	0.6360	a
" 19	18 3 5.2	7 29 29.15	+11 47 0.9	9.2514*n*	0.6236	b
" 28	16 58 3.9	7 49 47.35	+1 59 2.2	9.4197*n*	0.7263	c
Oct. 14	15 38 4.2	8 41 0.54	−24 22 7.6	9.5993*n*	0.8482	d

These observations were all made with the 9.6 inch telescope.

The following are the mean places of the stars for 1882.0, and their reduction to apparent places for the date of observations.

No. of Star.	Mean α	Red. to app. p'l	comet—*	Mean Dec.	Red. to app. p'l	co'et—*	Authr'y
	h m s	s.	s.	° ′ ″	″	′ ″	Tr. Cir.
a	7 27 57.95	+2.76	— 36.22	+12 33 36.3	— 7.9	+7 23.9	"
b	7 28 11.99	+2.78	+1 14.38	+11 49 44.4	— 7.7	—2 37.8	"
c	7 48 20.43	+2.72	+1 24.20	+ 1 59 54.1	— 5.7	— 46.2	"
d	8 41 0.53	+3.42	— 3.41	—24 14 32.2	— 18.2	—7 17.2	"

Naval Observatory, Nov. 21, 1882. EDGAR FRISBY.

METEORS OF NOVEMBER 14, 1882.

Professor DANIEL KIRKWOOD of Bloomington, Ind., reports that—

"On the morning of November 14 Mr. D. E. HUNTER, principal of the Washington high school, Washington, Indiana, watched for meteors from 3^h 10^m to 5^h 11^m. The numbers seen in successive half hours were as follows:—

	Conform.	Unconform.	Total.
From 3^h 10^m to 3^h 40^m	14	16	30
3 40 to 4 10	16	9	25
4 10 to 4 40	4	4	8
4 40 to 5 11	14	7	21
Meteors in two hours,	48	36	84

During the first hour Mr. HUNTER had four assistants, and during the second, three. The visible paths of the Leonids were unusually short; thirty not exceeding ten degrees in length. The morning of the 15th was cloudy.

Under date of November 7, Professor KIRKWOOD also wrote, that he observed the comet that morning between five and six o'clock.

"The nucleus had nearly the brightness of a star of the third magnitude. The tail was 12° or 13° long, and its breadth, about 9° from the nucleus, was nearly 2°. If it is identical with the comet of 1880, and if it is to return within a year or two, observations will certainly soon indicate the fact."

Professor E. C. PICKERING, of Harvard college observatory has prepared and published in pamphlet form, a plan for securing observations of the variable stars, It is well known to astronomers that this observatory is doing much careful, extended and systematic work in the study of the variable stars; and this plan has been devised to bring this interesting branch of astronomy to the attention of observers generally, and to secure desirable and needed cooperation in it. The work is easy, but very useful, and the plan is so minutely developed as to offer a delightful field of study to amateurs for observation with the naked eye, the common opera-glass or the small telescope. Correspondence is desired with any persons who wish to undertake this work. Prominent parts of the plan will be published next month.

Professor L. SWIFT, of Warner observatory, sent a sketch of Gould's comet, as observed on the mornings of October 9 and 10. It came too late for last issue. He said: "I could trace the tail toward the sun 3° from the nucleus which is single and not double as has been reported.

Mr. CORRIGAN has computed a set of elements for this comet which are almost identical with one of the sets computed for the comet of 1668, and the probability that they are identical appears to be stronger than its identity with either 1843 or '80."

Professor H. S. S SMITH, of Lawrence, Kansas, is planing a public time service for the state.

In giving the report of his comet observations last month, we should have said that he used a power of 14 instead of 141 with the comet-seeker.

Our thanks are due Mr. C. H. ROCKWELL for courteous invitation to join his party to observe the transit of *Venus* in eastern New York.

The fact that Dr. C. S. HASTINGS, of John Hopkins University, called attention merely to the coincidence of sun-spot activity and the close approach of *Gould's* comet to the sun on September 17 excited our interest and we sought and published his remarks; for they were so much like the views of Professor DANIEL KIRKWOOD published in 1871 "*On the great sun-spot of* 1843" and its relation to the great comet of that year, that we thought the fact should have permanent record. Subsequently, however, Dr. HASTINGS is the first person to call our attention to the further fact that he had learned by correspondence with the director of the Magnetic observatory of Toronto, that at the time above mentioned the magnetic conditions were unusually quiescent, and hence that he thinks the supposed connection is improbable.

On October 11, 1882, I 'picked up' a minute speck of a nebula whose light is about that of a 12 mag. star and which I suppose to be new. It is about 20′ *n. p.* a small star of the 8th or 9th mag. A careful approximation to the star's position, with the aid of the finder is,—

A. R. $1^h\ 39\frac{1}{4}^m$
Decl. $+ 27°\ 56'$.

By a direct vision it is quite faint, but by averted vision it is pretty distinct. Possibly there is a faint nebulosity closely surrounding it. The position of the star given will not be in error more than 4′ or 5′.

E. E. B.

Mr. WENDALL at the Harvard college observatory has kindly obtained the position of my new nebula near *Phi Virginis* with the large equatorial. The mean position for 1882.0 is

A. R. $14^h\ 16^m\ 19^s.6$
Decl. $+ 0°\ 9'\ 14''$.

He describes it as being "rather diffuse and faint, but gradually a little brighter in the middle." E. E. B.